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GEOPHYSICAL VARIABLES AND BEHAVIOR: LIII. EPIDEMIOLOGICAL CONSIDERATIONS FOR INCIDENCE OF CANCER AND DEPRESSION IN AREAS OF FREQUENT UFO REPORTS

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Summary.—Luminous phenomena and anomalous physical forces have been hypothesized to be generated by focal tectonic strain fields that precede earthquakes. If these geophysical processes exist, then their spatial and temporal density should be greatest during periods of protracted, localized UFO reports; they might be used as dosimetric indicators. Contemporary epidemiological data concerning the health risks of power frequency electromagnetic fields and radon gas levels (expected correlates of certain tectonic strain fields), suggest that increased incidence (odds ratios greater 1:3) of brain tumors and leukemia should be evident within "flap" areas. In addition the frequency of variants of temporal lobe lability, psychological depression and posttraumatic stress should be significantly elevated. UFO field investigators, because they have repeated, intermittent close proximity to these fields, are considered to be a particularly high risk population for these disorders.

Anomalous luminous displays, often described as verified UFO (unidentified flying object) reports, have been hypothesized to be generated by extremely local (< 100 m^2), intense and brief (a few minutes) tectonic strain fields that accompany increasing earth stresses (Persinger & Derr, 1984). Some luminous phenomena that precede or accompany regional earthquake activity are associated with release of radon gas and the emission of energetic low frequency electromagnetic fields (Derr, 1973; Yasui, 1974).

The extension of this concept is that luminous displays are an extreme (or one type of) manifestation of tectonic strain fields which mediate their effects through mechanisms that generate extremely powerful forces; the specific mechanism may vary according to tectonic history and local geochemistry (Persinger, 1985). Within an active region, intense electromagnetic fields from less visible events might occur briefly but very frequently within the vicinity for periods of months to years (Persinger, 1985). Cumulative exposures of proximal human populations would be substantial. If this extrapolation were correct, then epidemiological analysis should demonstrate increased elevations of specific cancers and psychiatric disorders in these areas following active (flap) periods. The clinical consequences of single, intense exposures ("close encounters") have been discussed elsewhere (Persinger, 1983).

Most cancers are extragenetic in origin (Landrigan, 1983). Two possible

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oncogenetic components of tectonic strain fields exist, (1) the penetrating magnetic component of extremely low frequency or pulsed radiofrequency ranges and (2) the release of radon gas. Several epidemiological studies (Lin, Dischinger, Conde, & Farrell, 1985; Milham, 1982; Savitz, 1988) have shown that prolonged exposure to power frequency magnetic fields increases the incidence of specific brain tumors (glioblastomas and astrocytomas), leukemia and cancers of the reproductive organs. Radon gas, which is concentrated in soils around strong acidious faulted rocks, such as outcrops of quartz diorite, has been implicated in lung cancer (Nero, Schwehr, Nazaroff, & Revzan, 1986).

The epidemiological pattern of cancers as a function of exposure to power frequency magnetic fields suggests that they may promote certain cancers (Lin, *et al.*, 1985; Savitz, 1988). Intensities of low frequency magnetic fields that may elevate the incidence of brain tumors and leukemia over background levels exceed 2 milligauss (a surprisingly frequent exposure level in homes near some overhead powerlines); estimated durations of intermittent exposure range from 2 to 5 yr. Single, brief (10 hr.) exposure to magnetic fields within this order of magnitude can influence cell division by affecting DNA synthesis (Liboff, Williams, Strong, & Wistar, 1984). In addition, brief (5 to 10 days) exposures to rotating magnetic fields (10 to 100 gauss) have specific effects on testicular and thymic activity in nonhuman animals (Persinger, Carrey, Lafreniere, & Mazzuchin, 1978). Transient, low-frequency magnetic fields with field strength several powers of 10 higher than these levels have been suspected as correlates of luminous phenomena (Persinger, 1983, 1985); the fields might release energy as brief bursts of activity (Persinger & Cameron, 1986).

According to recent estimates (Nero, *et al.*, 1986), the 0.3% life-time risk of lung cancer in homes with 1.5 picoCuries/l of radon gas increased to 2% with exposure levels of more than 8 picoCuries/l (approximately 1 million homes in the USA). Unexplained anomalous background levels exceeded 50 picoCuries/l. Unfortunately these measurements were taken without consideration for increases in local tectonic stresses as indicated by either reports of luminous phenomena or regional earthquake activity. Periodic enhancement of radiation levels by more than a factor of between 10 and 100 could be expected before seismic activity. Burst releases (about 10 sec.) of radioactivity that was more than a factor of 15 over background levels have been reported even during very weak luminous displays along the Ramapo fault line in New Jersey (Wiedemann, 1977).

Although traditional epidemiology has tended to avoid the study of the incidence of psychiatric disorders, they are amenable to such analysis (Landrigan, 1983; Persinger, 1987). Exposure to time-varying environmental magnetic fields, similar to (but much less intense than) those hypothesized

to be associated with transient geophysical forces, has been implicated as a source of psychological depression (Wilson, 1988). The mechanism may involve nocturnal alterations in pineal melatonin, an important metabolite in the serotonin pathway. Although the most common presenting complication of depression is elevated risk of suicide, this form of affective disorder may operate to promote cancer through maintained immunosuppression; see Irwin, Daniels, and Weiner (1987) for list of references.

The most prominent psychiatric disorders would involve variants of temporal lobe dysfunction. They would be particularly evident in people with specific personality profiles (Persinger, 1989) that suggest temporal lobe lability (Persinger & Makarec, 1987). Because long-term potentiation (LTP) can be generated by very brief (a few seconds) bursts of 100- to 400-Hz electrical currents within limbic structures (Winson & Dahl, 1986), these sensitive individuals would be vulnerable. Short bursts of electromagnetic fields during "flap" periods have been reported (Persinger & Cameron, 1986). The recent evidence that brief electrical seizures can generate c-*fos* gene activity (that encodes nuclear protein and exhibits DNA-binding), in limbic structures (Morgan, Cohen, Hempstead, & Curran, 1987) strongly suggests that changes in memory and behavior could occur.

If the spatial and temporal densities of tectonic strain fields are markedly elevated in regions during the report of persistent luminous phenomena, then the above disorders should be more prevalent following each successive episode. A clear, increased incidence of posttraumatic stress, variants of limbic dysfunctions and depression-related disorders should be evident first (even while the episode is still occurring), followed by leukemia (especially in younger children) and then brain tumors and lung cancer in the older population.

Areas (dates of major displays in parentheses) in which luminous phenomena were highly localized (occurring within a radius of about 50 km) for several months include the Uinta Basin (1967), Carman, Manitoba (1975-1976), Yakima, Washington (1972-1975), Zeitoun, Egypt (1968-1969), and Hessdalen, Norway (1984-1985). More contemporary areas are near Chippewa Falls, Wisconsin, the Hudson River Valley and Medjugorje, Yugoslavia. Perhaps the most intense single focal display this century occurred during October, 1917 when several thousands of people observed a very bright luminosity near Fatima, Portugal. Anecdotally, two of the three children who had the greatest numbers of proximal exposures died within three years (one from symptoms that suggest a solid lung tumor with concomitant hypercalcemia).

It should be evident that two high-risk groups involve people who have singular very intense close encounters with luminous phenomena and those who have frequent, intermittent exposures over a lifetime. The latter group

would involve UFO field investigators. Because they work in the vicinity of luminous phenomena (often camping near the sites), UFO field researchers would be predicted to be particularly prone to brain tumors, testicular cancer, and leukemia. Psychological stress, such as hectic traveling and altered sleep schedules would facilitate immunosuppression, a factor that would promote any aberrant mitosis. Moderate to severe psychological depression that would require medication is likely; however, it might be reflected in substance (alcohol) abuse. The incidence of mild temporal lobe symptoms, such as delusions, extreme egocentric interpretation of events, a belief in personal destiny, and the sense of a presence (Persinger, 1983, 1984, 1989) should be conspicuous.

The magnitude of the effect is difficult to predict in light of the likely variable exposure schedules and unclear dosimetry of tectonic strain fields; many UFO investigators have no actual history of close proximity to luminous phenomena. Assuming some linearity from epidemiological data, the lifetime risk for lung cancer in people living in an active region should exceed 2%. The ratio for leukemia and brain tumors should be in excess of 1:3. For UFO field researchers the lifetime risk of developing these disorders should be markedly elevated. Obviously not every field investigator or person who has had a single intense exposure to such phenomena would develop these disorders. However, at such expected incidence levels, the presence of a tectonic strain factor should be evident in a controlled epidemiological study.

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